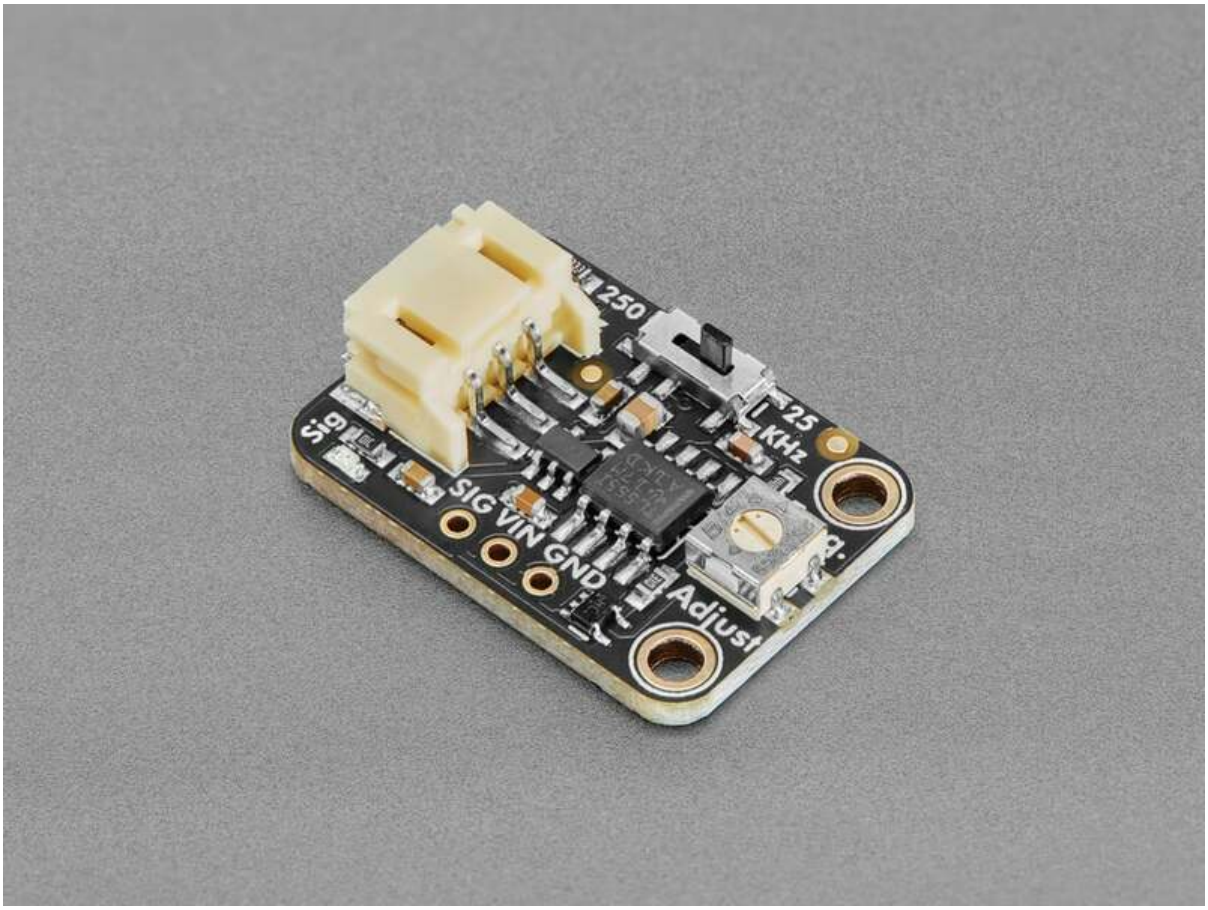
Adafruit 555 PWM Output STEMMA

Created by Liz Clark



https://learn.adafruit.com/adafruit-555-pwm-output-stemma

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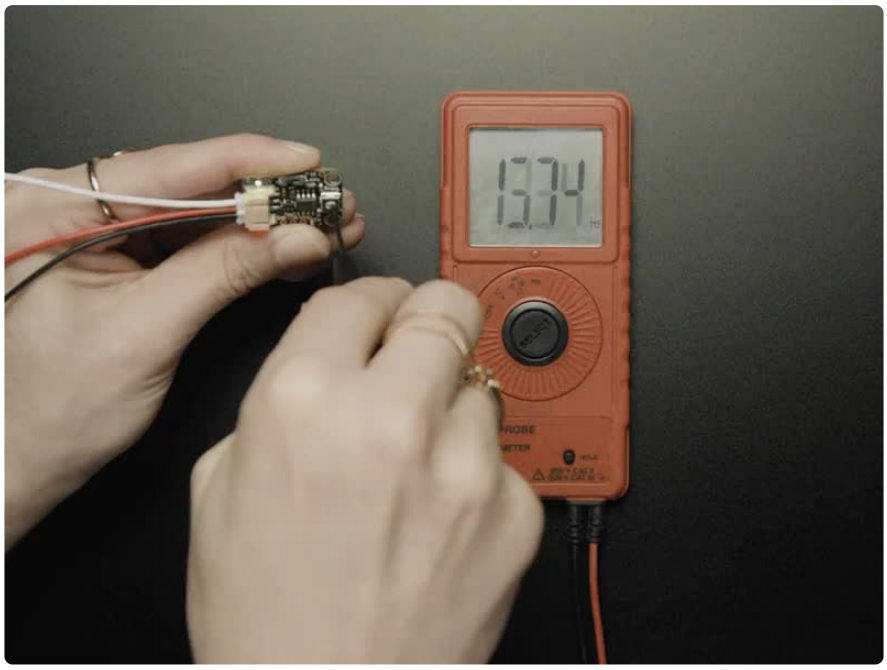
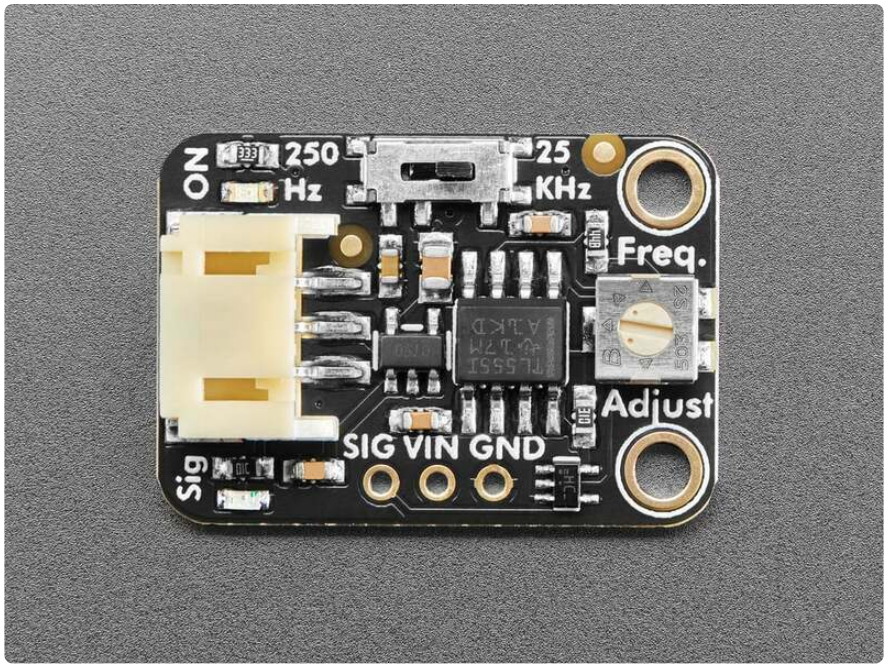
Overview

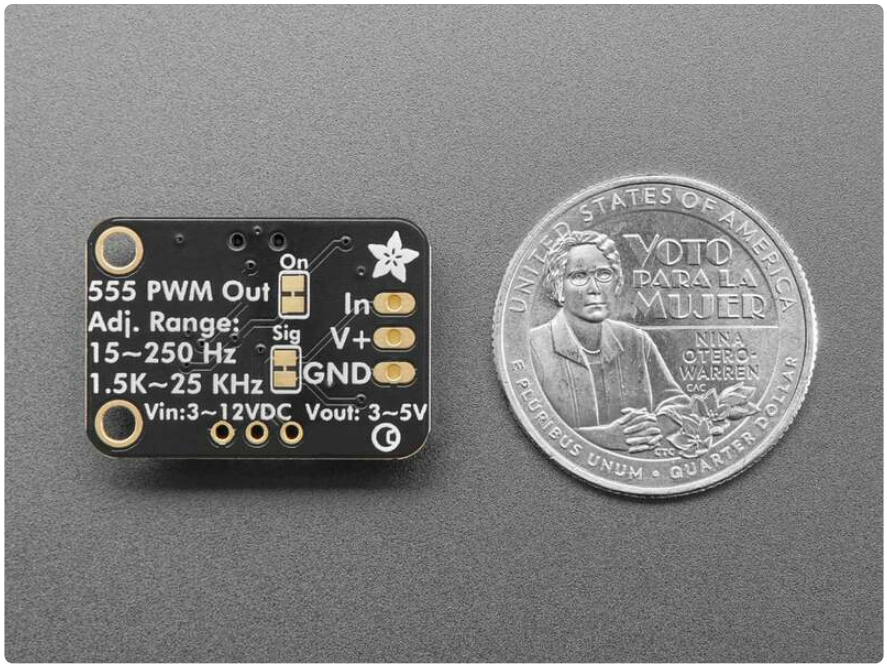


How many times have we heard "hey you could have just replaced that microcontroller with a 555"? Maybe 555 times! But we always find wiring up a timer chip to be a bit of a pain, you need quite a few components - especially if you want a buffered output.

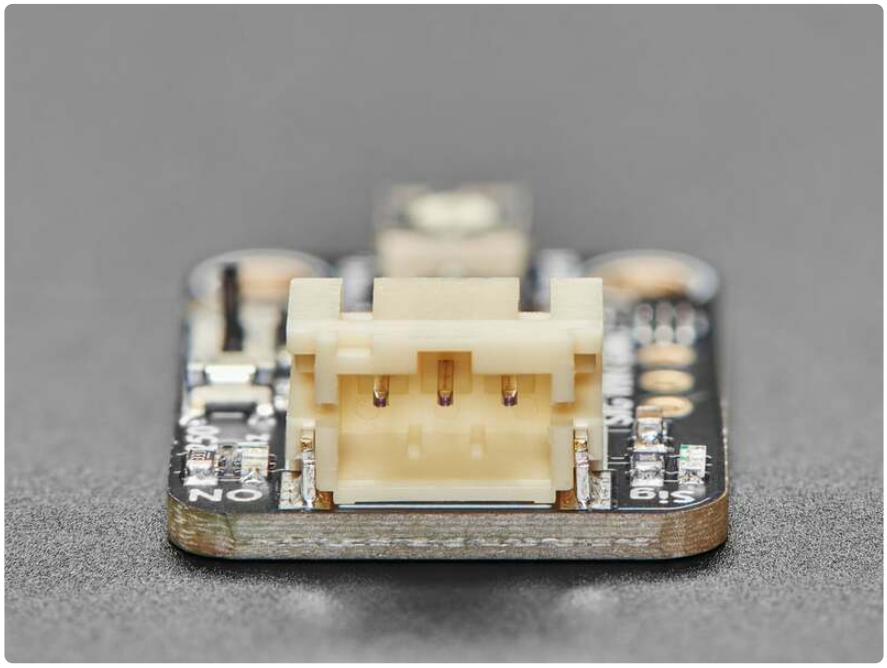
That's why we designed the **Adafruit 555 PWM Output STEMMA** - a fully-assembled 555 timer board with adjustable PWM square-wave output.



We originally came up with this idea when someone requested we make a 'PC Fan Dummy' board, that can generate a 100Hz signal for faking a PC fan's tachometer signal to a motherboard. But then we thought that sometimes we want a square wave for driving a piezo, or as an audio input, or to modulate an IR signal. So we made it a little more general-purpose.



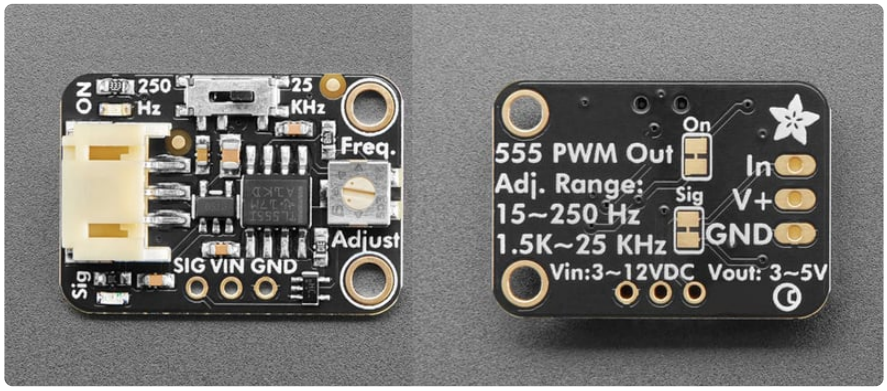
You can select between two 'ranges': approximately 1.4K~25 KHz or 1.4~250 Hz. The onboard trimmer pot will tune the actual output between those values. You can use a logic analyzer, oscilloscope, multimeter with frequency-counting, or even an audio input jack on a computer, to determine the precise value if you need more than a rough number. The output is a DC square wave, driven by a 74HC1G04 (https://adafru.it/1a0E) buffer so it can sink/source up to 12.5mA.



You can power the board from 3V to 12VDC, an onboard regulator will pin the input to the 555 and buffer to 5V max. That means that between 3V and 5V power, the signal peak will be at the same logic level as the power. Above 5V, the output will be pegged to 5V.

Each STEMMA board is a fully assembled and tested PCB but no cable. No soldering is required to use it, but you will need to pick up a 2mm pitch, 3-pin STEMMA JST PH cable (https://adafru.it/18cS). Alternatively, if you do want to solder, there's a 0.1" spaced header for power/ground/signal.

Pinouts



The 50% duty cycle for the output cannot be changed.

Power Pins

- **VIN** - this is the power pin. To power the board, provide 3V to 12VDC. There is an onboard regulator that will pin the input to the 555 and buffer to 5V max. That means that between 3V and 5V power, the signal peak will be at the same logic level as the power. Above 5V, the output will be pegged to 5V.
- **GND** - common ground for power and logic.

Signal Output

- **SIG** - this is the output signal from the 555 timer. It is a DC square wave, driven by a 74HC1G04 (https://adafru.it/1a0E) buffer so it can sink/source up to 12.5mA.

STEMMA JST PH

- **STEMMA JST PH** (https://adafru.it/Ft4) - 2mm pitch STEMMA JST port for use with 3-pin STEMMA JST PH cables (https://adafru.it/JRA). It has connections for:
    - **GND** - common ground for power and data. It is the black wire on the JST PH cable.
    - **VIN** - power input for the 555 timer. It is the red wire on the JST PH cable.
    - **SIG** - signal output from the 555 timer. It is the white wire on the JST PH cable.

Range Selection Switch

On the top right of the board is a slide switch labeled **250 Hz** and **25 KHz** on the board silk. This switch selects between two 'ranges' for the 555 timer output: approximately 1.4~25 KHz or 1.4~250 Hz.

Frequency Adjustment Trimmer Pot

At the end of the board, opposite the JST PH port, is a trimmer pot. It is labeled **Freq. Adjust** on the board silk. This pot adjusts the actual frequency output from the 555 timer between the value range that you select with the selection switch.

Signal LED and Jumper

- **Signal LED** - to the left of the JST PH connector is the signal LED, labeled **Sig**. It is the red LED. It will light up when a signal is output from the 555 timer.
- **LED jumper** - in the center of the back of the board is a jumper for the signal LED. It is labeled **Sig** on the board silk. If you want to disable the signal LED, cut the trace on this jumper.

Power LED and Jumper

- **Power LED** - to the right of the JST PH connector is the power LED, labeled **ON**. It is the green LED.
- **LED jumper** - in the center of the back of the board is a jumper for the power LED. It is labeled **On** on the board silk. If you want to disable the power LED, cut the trace on this jumper.

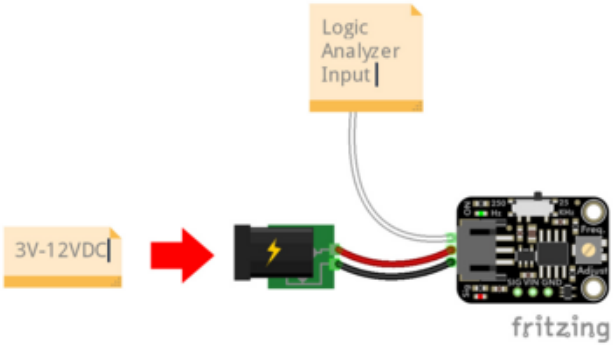
Use

You can use a logic analyzer, oscilloscope, multimeter with frequency-counting, or even an audio input jack on a computer, to determine the precise value from the output of the 555 timer. This breakout lets you adjust the frequency of the output from the 555 timer. The output is always a 50% duty cycle square wave driven by a 74HC1G04 (https://adafru.it/1a0E) buffer.

The 50% duty cycle for the output cannot be changed.

Wiring

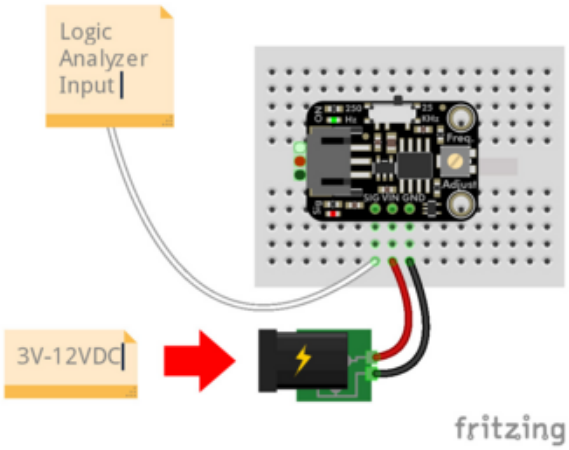
You can power the board with 3V to 12VDC. You can connect the **SIG** pin to your chosen analyzer input. The following is the board wired up using a JST PH cable:



Power supply VOUT to **breakout STEMMA Vin (red wire)**
Power supply GND to **breakout STEMMA GND (black wire)**
Breakout STEMMA SIG to **analyzer input (white wire)**

STEMMA JST PH 2mm 3-Pin to Male Header Cable - 200mm
This cable will let you turn a JST PH 3-pin cable port into 3 individual wires with high-quality 0.1" male header plugs on the end. We're carrying these to match up with our...
https://www.adafruit.com/product/3893

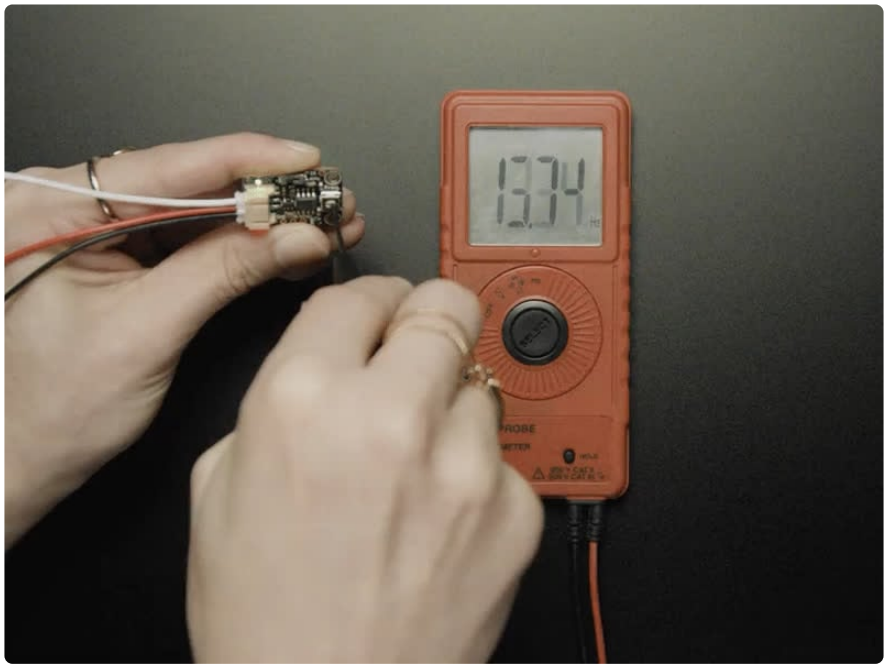
The following is the breakout wired up using a solderless breadboard:



Power supply VOUT to **breakout Vin (red wire)**
Power supply GND to **breakout GND (black wire)**
Breakout SIG to **analyzer input (white wire)**

Analysis

After the 555 is powered up, setup your chosen analysis tool. Select your frequency range with the slide switch and then fine-tune the frequency using the trimmer pot on the board. You'll see the frequency change on your tool as you adjust these settings on the board.



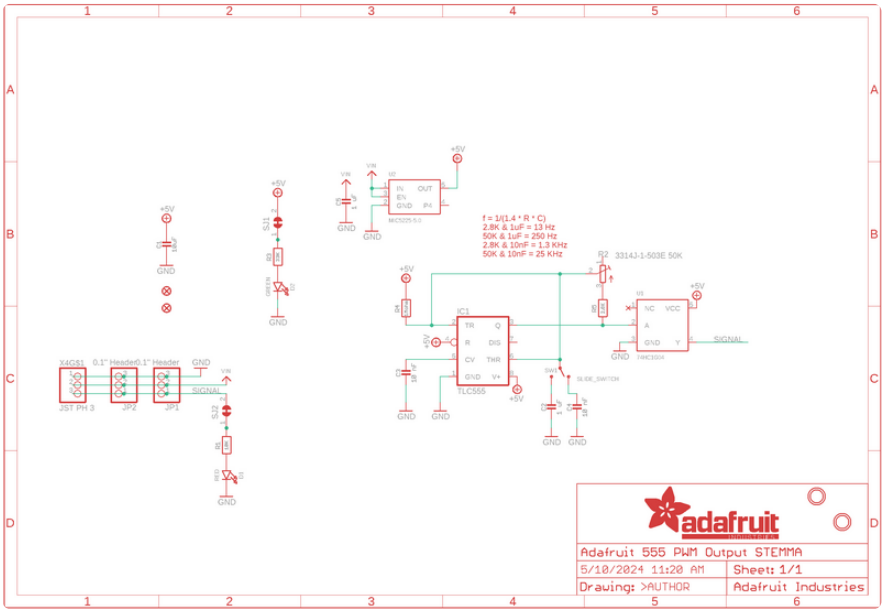
Downloads

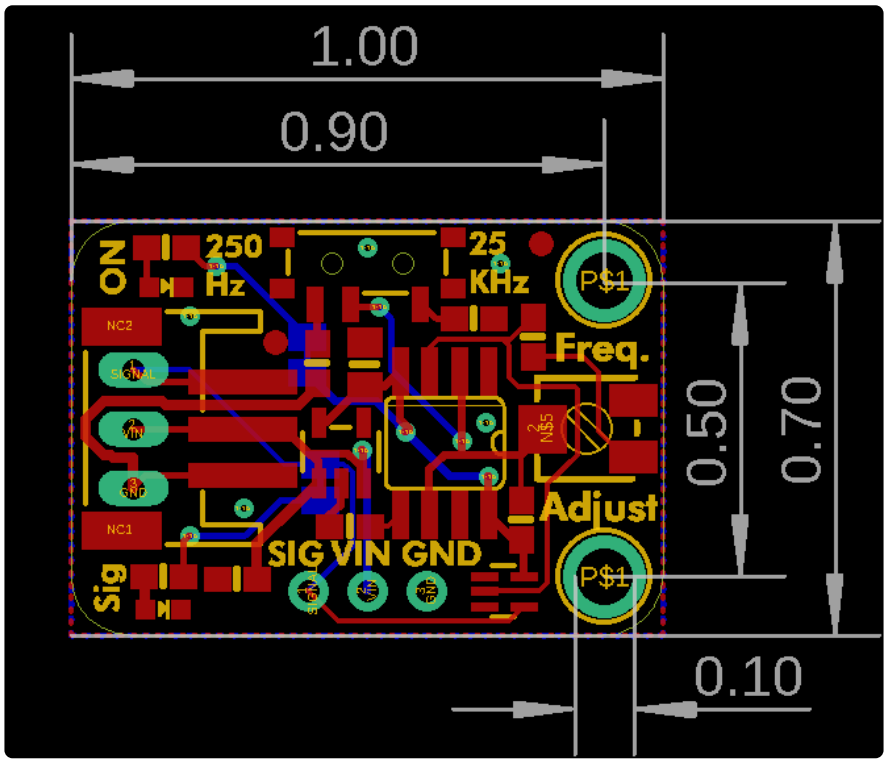
Files

- 555 Datasheet (https://adafru.it/1a0F)
- EagleCAD PCB Files on GitHub (https://adafru.it/1a0G)

- Fritzing object in the Adafruit Fritzing Library (https://adafru.it/1a0H)

Schematic and Fab Print



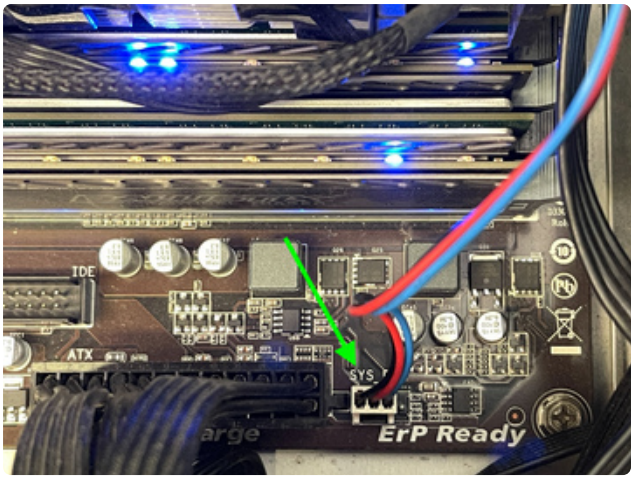


PC Fan Dummy

Here's how to use the 555 PWM Output STEMMA to trick your PC into thinking there's a fan running. This is useful when you've replaced the air cooling fans on your CPU or other parts of the system with liquid cooling radiators and pumps, such as a water cooled or oil cooled rig.

Some motherboard and BIOS combinations may not allow you to disable the fan alarms and may not allow you to boot past the POST test without a fan (or fan dummy) in place.

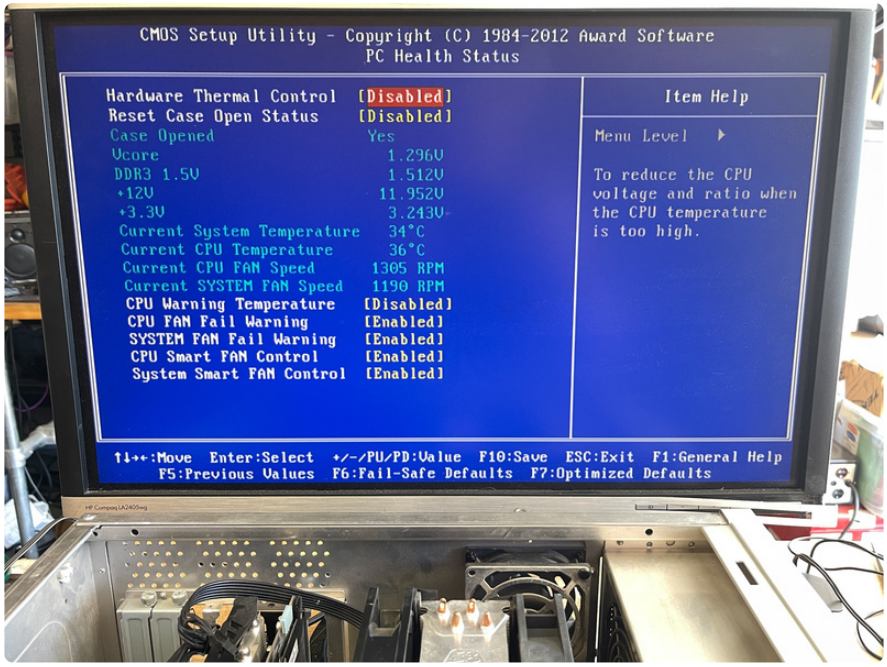
Since the fan headers on the motherboard contain a signal pin that watches for 5V square wave pulses, we can plug the 555 PWM Output STEMMA in and tell a big fat lie to the motherboard!

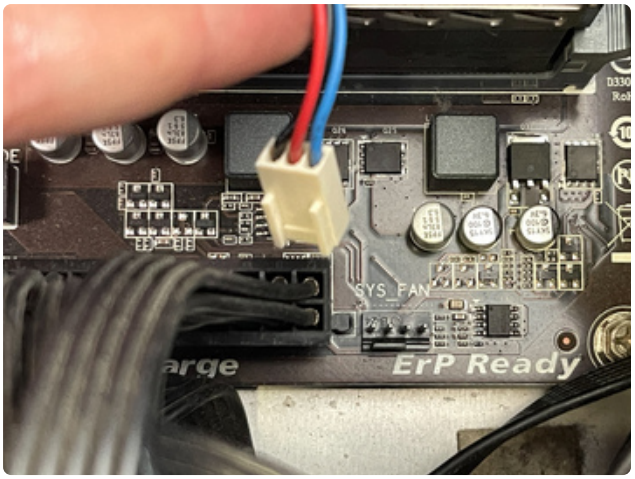


Normal System Fan Operation

Here we have a small (and noisy!) system fan connected to the motherboard SYS FAN header.

As it spins, a small magnet on the fan hub spins and triggers pulses from a Hall effect sensor. It's reporting `Current SYSTEM FAN Speed 1190 RPM`, which makes the BIOS happy.

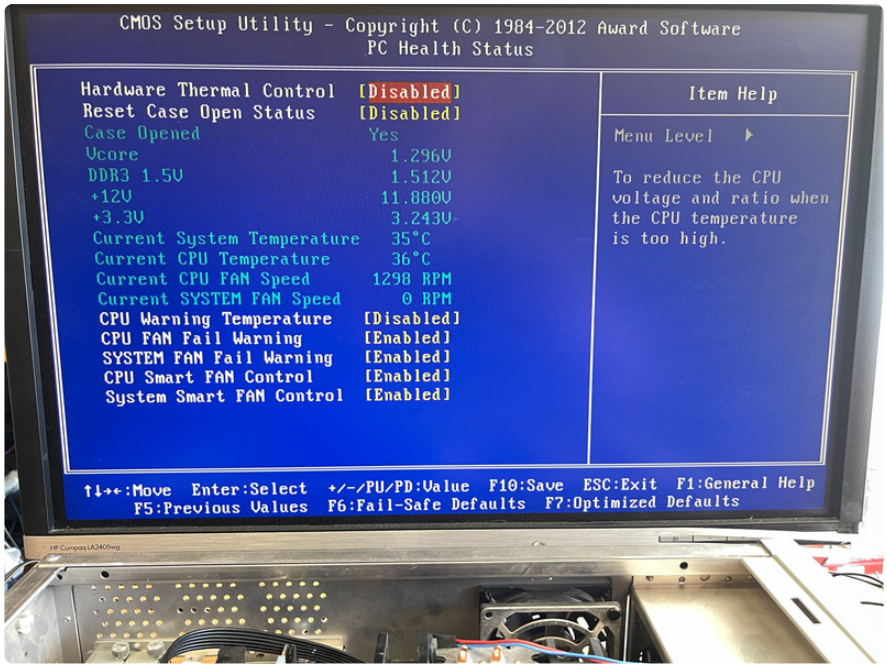


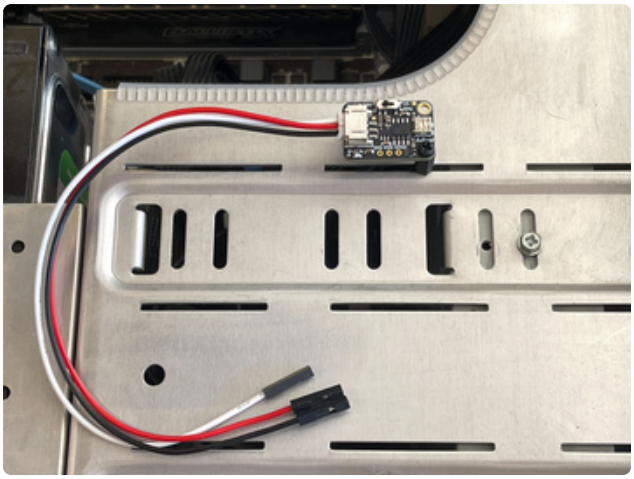


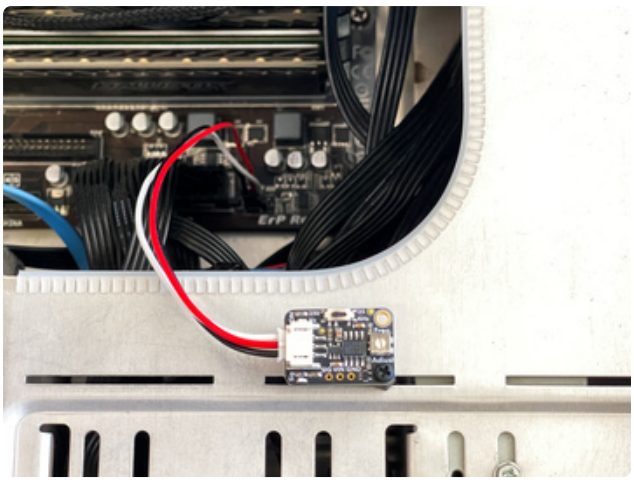
Fan Unplugged

I've unplugged the system fan!

The BIOS causes the system speaker to blare a horrible, annoying beep and reports `Current SYSTEM FAN Speed 0 RPM`





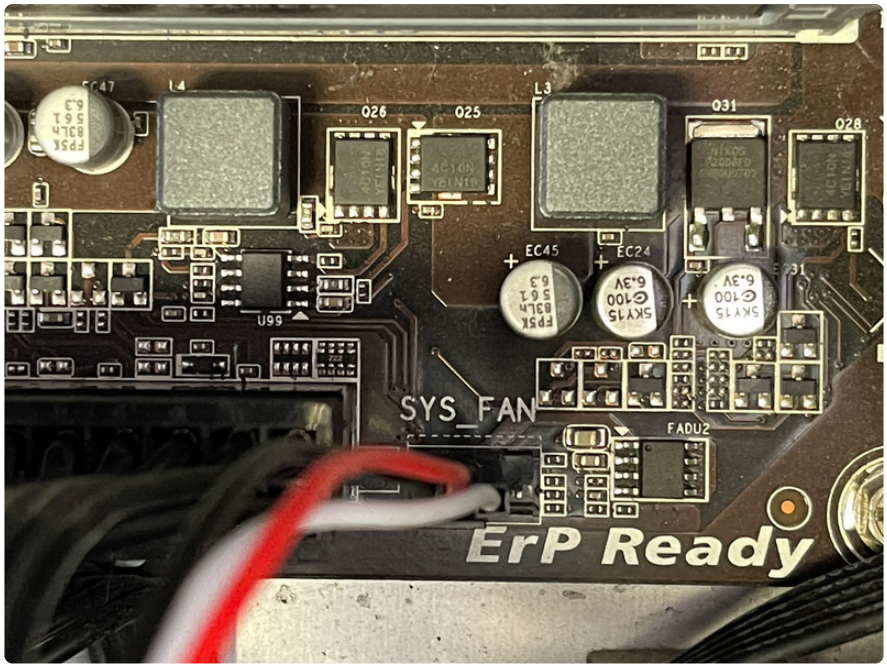


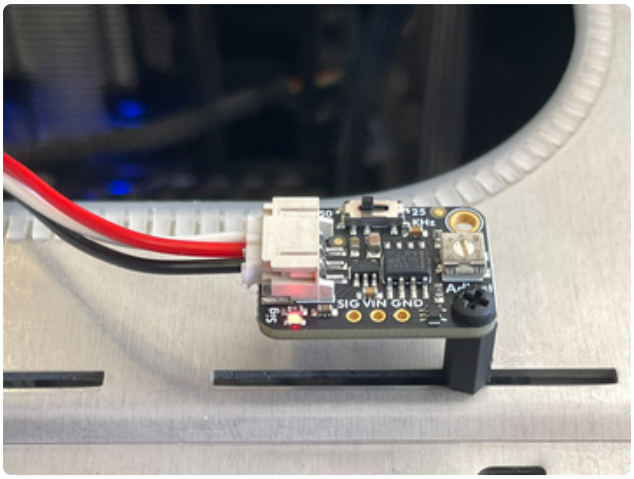
555 PWM Output STEMMA

Here comes the 555 PWM Output STEMMA to the rescue!

I've plugged in a STEMMA JST 3-pin cable with DuPont female connectors (http://adafru.it/3894):

Red to 5V
Black to GND
White to tachometer signal
Consult your motherboard's manual to be certain of pinout.

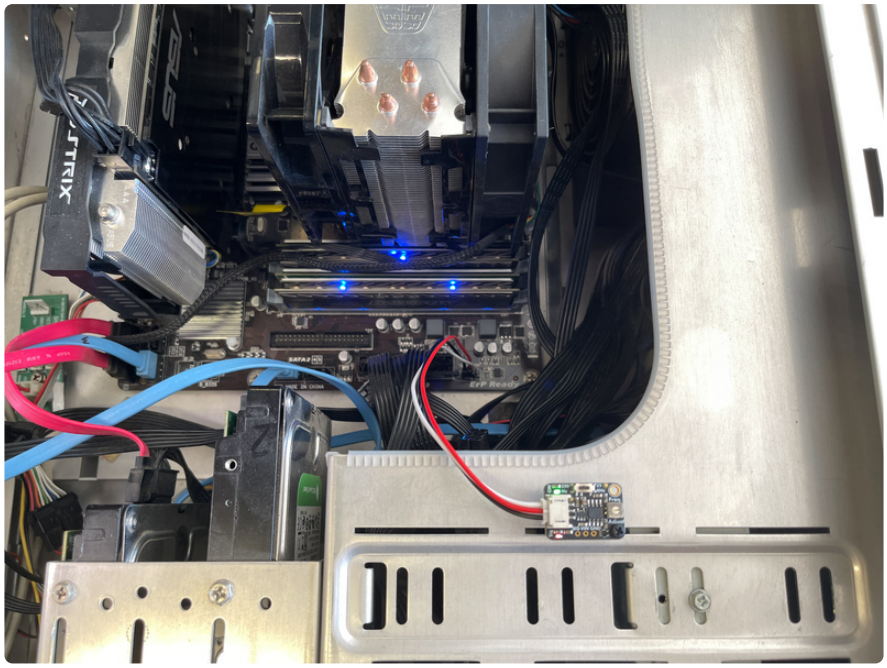


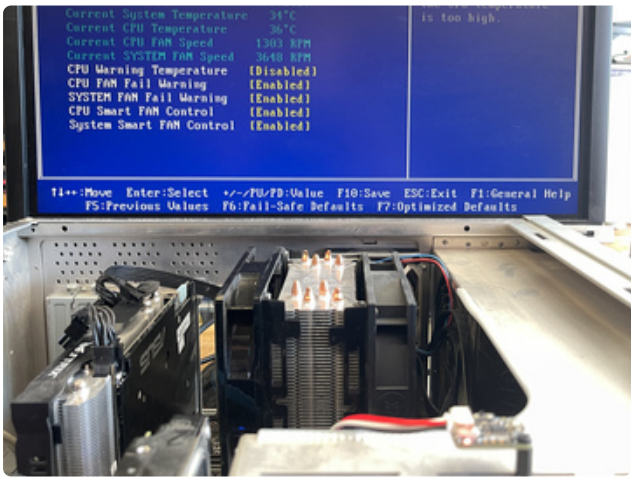


555 Range

The range selector switch on the 555 PWM Output STEMMA should be flipped left, to the lower range.

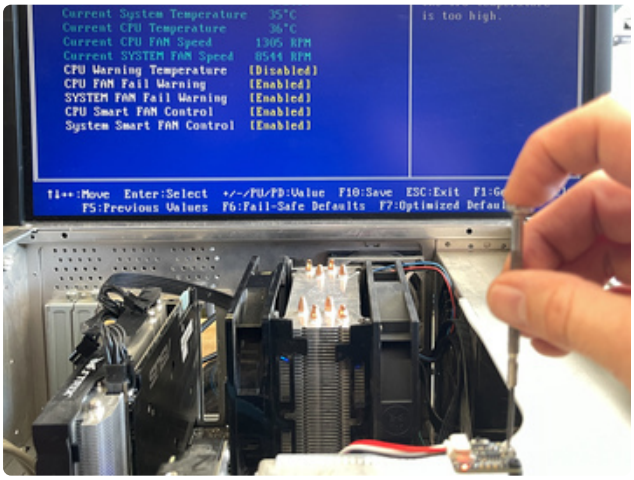
The LED indicators will light up for power (green LED on top) and signal (red LED on bottom, which pulses at the output frequency).





Fake-out!

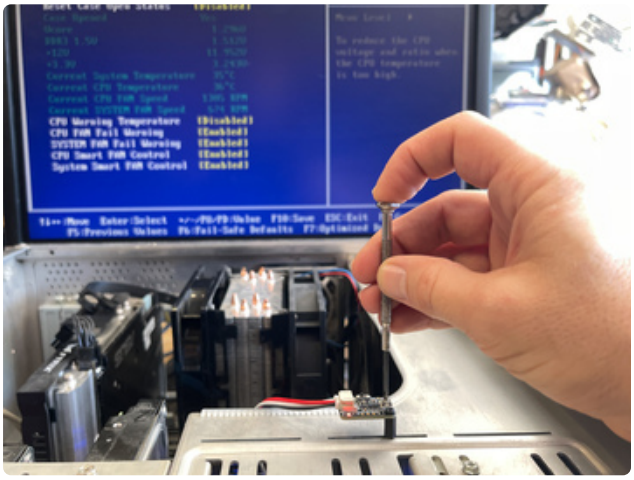
Ha! The BIOS now reports that the "fan" is spinning along happily at `3648 RPM`.



SUPER SONIC

You can use a small flathead screwdriver to turn the trimmer pot to the right to increase the pulse speed. Now the BIOS thinks the fan is roaring along at over `8500 RPM`!

This won't impact the computer at all, although some BIOS setups may dislike speeds outside of a normal range, usual around `1000 RPM`.



Slowpoke

Turn the trimmer pot to the left and -- oops, too slow! Now it reads around `675 RPM`.

Just Right

There we are, `1025 RPM` ought to keep everyone happy and now you can get on with your liquid cooling dreams! All thanks to a venerable 555 timer and a little bit of fibbing.


PC Health Status
Hardware Thermal Control [Disabled]
Reset Case Open Status [Disabled]
Case Opened Yes
Vcore 1.296V
DDR3 1.5V 1.512V
+12V 11.952V
+3.3V 3.263V
Current System Temperature 35°C
Current CPU Temperature 36°C
Current CPU FAN Speed 1305 RPM
Current SYSTEM FAN Speed 1025 RPM
CPU Warning Temperature [Disabled]
CPU FAN Fail Warning [Enabled]
SYSTEM FAN Fail Warning [Enabled]
CPU Smart FAN Control [Enabled]
System Smart FAN Control [Enabled]
Item Help
Menu Level
To reduce the CPU voltage and ratio when the CPU temperature is too high.
↑↓→←:Move Enter:Select +/-/PU/PD:Value F10:Save ESC:Exit F1:General Help
F5:Previous Values F6:Fail-Safe Defaults F7:Optimized Defaults

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